DOCUMENT RESUME

ED 383 131 EC 303 953

AUTHOR Kucera, Thomas J., Ed.
TITLE Teaching Chemistry to Students with Disabilities., Third Edition.
INSTITUTION American Chemical Society, Washington, D.C.
SPONS AGENCY National Science Foundation, Washington, D.C.
REPORT NO ISBN-0-8412-2734-9
PUB DATE Aug 93
CONTRACT SPI-7908737
NOTE 50p.
PUB TYPE Guides - Classroom Use - Teaching Guides (For Teacher) (052) -- Reference Materials - Directories/Catalogs (132)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Access to Education; *Chemistry; Classroom Design; *Computer Assisted Instruction; *Disabilities; Educational Testing; Elementary Secondary Education; Hearing Impairments; Laboratory Safety; Learning Disabilities; Physical Disabilities; *Science Instruction; *Science Laboratories; Student Evaluation; Visual Impairments

ABSTRACT

The third edition of this guide for teaching chemistry at all levels to students with disabilities covers classroom adaptations, testing and evaluation, computers in the classroom and laboratory, laboratory design, and laboratory safety. The needs of the growing population of students with learning disabilities are addressed, along with the needs of students with hearing, visual, and mobility impairments in the classroom, in using computers, and in the laboratory. A resource section provides sources of information on the Americans with Disabilities Act, descriptions of organizations involved in the education of students with disabilities, a list of guides to colleges and universities that have services for students with disabilities, information on national organizations and hotlines listed by type of disability, and information on selected teaching and laboratory aids and computer materials for persons with disabilities. Contains 77 references. (SW)

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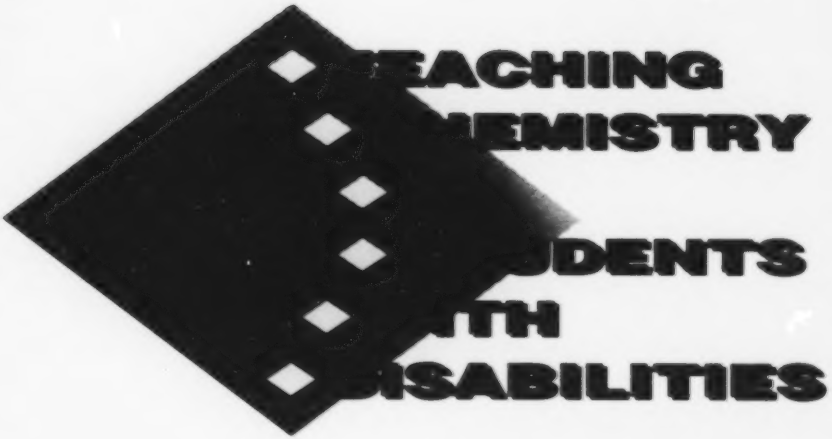

TEACHING CHEMISTRY TO STUDENTS WITH DISABILITIES

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THE GOAL OF THE ACS COMMITTEE ON CHEMISTS WITH DISABILITIES (CWD) is to promote access by individuals with disabilities to educational and career opportunities in the chemical and allied sciences. The Committee has prepared a manual, *Teaching Chemistry to Students with Disabilities* (now in its third edition), that is a useful and sensitive source of advice and information for chemistry instructors on how to foster full participation of students with disabilities in the laboratory or classroom. ACS distributes this manual to chemistry instructors and individuals upon request. The manual makes a most important point that students with disabilities wish to be judged against the recognized standards of academic achievement. Students with disabilities have highly individualized needs, depending on the nature of the disability, and will learn best when those needs are met. For example, students with impaired mobility, or impaired vision, may require an assistant to perform experiments under the student's direction. However, both CWD and the Committee on Professional Training take the position that a student's achievements in laboratory instruction should not be discounted because accommodations must be made. Assuredly, laboratory experience is essential, but the quality of that experience can be limited more by the lack of outreach efforts designed to work around the disability than by the disability itself. Some degree of accommodation in the laboratory or classroom will almost certainly be necessary in order to offer students with disabilities an effective education in chemistry. There is no justification in discounting the experience because it is nontraditional.

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◆TEACHING ◆CHEMISTRY ◆TO ◆STUDENTS ◆WITH ◆DISABILITIES

Thomas J. Kucera, Editor

American Chemical Society
Committee on Chemists with Disabilities

May 1981
December 1985 (2nd Edition)
March 1990 (2nd Printing)
August 1993 (3rd Edition)

Foreword to the 1993 Edition

The first and second editions of this booklet (formerly entitled "Teaching Chemistry to Physically Handicapped Students") were widely distributed in the United States and abroad. Indeed, the second edition was translated into Japanese by an interested colleague in Japan. Since the passage of the Rehabilitation Act of 1973 and the Individuals with Disabilities Education Act (IDEA) of 1975, virtually all public and private colleges and universities have been required to make their full range of educational opportunities accessible to students with disabilities. All educational institutions now also are required to comply with the provisions of the Americans with Disabilities Act of 1990 (ADA). ADA is a comprehensive national mandate to eliminate discrimination against individuals with disabilities in education, the community, and the workplace. More and more career opportunities in all fields, including the sciences, will be opened to individuals with disabilities. As a result, interest in scientific careers among students with disabilities has increased, as has the need for information concerning teaching chemistry to this growing population.

The third edition has been completely revised, updated, and the scope of coverage has increased. For the first time, information and resources are provided concerning students with learning disabilities, and the use of computers by students with disabilities in both the classroom and the laboratory is addressed.

Special appreciation goes to Dr. Todd A. Blumenkopf, who was Chairman of the ACS Committee on Chemists with Disabilities when the work on this edition was initiated and contributed much of the new material in this expanded edition. Also thanks to Dr. Thomas J. Kucera, who undertook the task of coordinating the major revision needed to update this booklet. Dr. Mark Dubnick and Profs. Anne Swanson and H. David Wohlers, also Committee members, contributed significantly to the revision. Ms. Sheryl Burgstahler of Computing and Communications of the University of Washington, Seattle, contributed much of the material on computers. Special thanks also go to Ms. Corinne Marasco of the American Chemical Society for her assistance in the preparation of this edition.

Dr. Thomas Doyle
Chairman
ACS Committee on Chemists with Disabilities

This manual is dedicated to the memory of Dr. James Hazdra who organized the workshop that led to the formation of the Committee on Chemists with Disabilities and of Dr. Robert Rehwoldt who served on the Committee with distinction.

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This material is based upon work supported by the National Science Foundation under Grant No. SPI-7908737. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the contributors and do not necessarily reflect the views of the National Science Foundation or the American Chemical Society.

Introduction

The basic requirements for teaching chemistry to students with disabilities are capable teachers and motivated students. However, awareness of useful refinements in teaching technique and of services, materials, equipment, and publications in the field may also prove valuable. This manual is designed to provide such information for both students and teachers, but is oriented primarily toward teachers of chemistry.

Many scientists and technicians with slight to severe disabilities are pursuing careers in science today in industry, education, and government (61). Nevertheless, young people with disabilities traditionally have not enjoyed full access to the kind of education that would permit them to follow careers of their choice. In part the problem has been simply the physical arrangement of school buildings and facilities. The main difficulty has been a set of deep-seated and pervasive attitudes toward persons with disabilities and the consequent barriers to young people aspiring to study science. Children with disabilities often have not been considered in the context of standard curricula, and there is good evidence that most students with disabilities until recently have not even been exposed to the sciences, including chemistry (6).

To help correct this situation, Congress passed the Rehabilitation Act of 1973 and the Education for All Handicapped Children Act of 1975. These measures were designed in part to make the full range of educational opportunities accessible to persons with disabilities.

Section 504 of the Rehabilitation Act provides that:

> *No otherwise qualified handicapped individual...shall, solely by reason of his handicap be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.*

All schools receiving federal funds are covered by this provision. The Act also provides for the removal of physical barriers to persons with disabilities in schools or other facilities receiving federal funds (57).

The Education for All Handicapped Children Act, now called the Individuals with Disabilities Education Act (IDEA), provides federal assistance to states for educational services for individuals with disabilities between ages 3 and 22. The intent is to guarantee full access to educational opportunity for all students with disabilities.

The Americans with Disabilities Act of 1990 (ADA) became effective July 26, 1992. There are four titles under ADA: Employment (66); State and Local Government Programs and Activities; Public Accommodations and Commercial Facilities; and Telecommunications. The Public Accommodations section of the Act extends accessibility to education including private schools as well as in most public meeting places, libraries, restaurants, museums, and public mass transportation.

The number of students covered by these laws is uncertain. The data are fragmentary and cover a wide range of impairments; furthermore, there are doubtless students with disabilities who do not consider or report themselves as disabled and so do not appear in the data. In any event, teachers of chemistry through the university level can expect to be teaching more students with disabilities than they have in the past. The largest numbers will be in high school and in non-chemistry majors, but an increasing number of students seeking associate, baccalaureate, and advanced degrees in chemistry can also be anticipated (32, 56, 60).

There are special awards to assist students with disabilities in pursuing study and research in science from the National Science Foundation (NSF) and the National Institutes of Health (NIH). NSF offers a "Facilitation Award for Scientists and Engineers with Disabilities" and NIH has "Research Supplements to Promote Recruitment of Individuals with Disabilities into Biomedical Research Careers."

The challenge after the degree is finding suitable employment as a chemist. The American Chemical Society (ACS) offers employment assistance for all members and Title I of ADA addresses the employment of people with disabilities. In any case, finding employment in a competitive job market requires well-developed strategies, especially for chemists with disabilities (74, 76).

This manual is organized in terms of the classroom, the laboratory, computer use, laboratory safety, and testing and evaluation. The discussion is not intended to be comprehensive, but to serve rather as a briefing for teachers whose classes will include students with disabilities. Access to a broad range of information and assistance is provided in Sources of Information. Similarly, 77 pertinent publications are listed in the Bibliography, and a few are cited by number within the text.

The use of computers in the chemical laboratory, and by chemists in general, rose dramatically during the 1980s. Adaptive hardware and software that allow individuals with disabilities to use computers have also become widely available. IBM, Apple, and other companies and organizations have established technical assistance and support centers for persons with disabilities (Sources of Information, Computer Help, p. 34) (23, 49).

A series of booklets under the general title *Barrier Free in Brief*, published recently by the AAAS Project on Science, Technology, and Disability, provides an excellent introduction to overcoming the barriers met by persons with disabilities in all aspects of the scientific endeavor (p. 28).

In the Classroom

From the teacher's point of view, students with disabilities have three kinds of classroom needs: those common among students in general; those that call for care in lecturing and leading discussions; and those that require special arrangements. Teachers as a rule can meet the first two categories of needs simply by following practices generally recognized to contribute to good teaching. The third category of needs—special arrangements—requires that teachers display flexibility, creativity, and leadership. Students with disabilities bear much of the everyday responsibility to make teachers aware of their special needs and to assist in finding potential solutions.

Classroom accommodations for students with disabilities tend to be individualized. Usually the students themselves are the best sources of information about their needs because they have learned what works best for them. The student should initiate with the teacher a frank discussion of how to meet special needs in the most practical way. Such discussion is best held before the semester begins to allow time for teacher and student to learn each other's requirements and make the necessary arrangements.

Students with disabilities may need to preregister and initiate a presemester discussion with the teacher on things that can be done before the semester begins. Once the term begins, the teacher can be alert to the potential needs of students and initiate a discussion when it seems appropriate. Other teachers and counselors can help by identifying students with special needs who will be entering the class. Also, students with disabilities are encouraged to preregister so that the information can be given to the department chairperson or other responsible individual in a timely fashion. To repeat, it is essential that adequate time be allowed for planning before the semester begins.

It is imperative that the student be personally involved in discussions of special arrangements. Unfortunately, teachers uncertain of what to do might bypass the student and consult only other teachers or advisors. The result of such a procedure is explained by a person with a disability who earned a doctorate and is now a practicing research chemist: "I was constantly frustrated in my attempts to arrange presemester conferences by teachers who said that they had 'already spoken to so-and-so and everything was arranged.' This left me completely in the dark about what had been arranged and unable to express my views on what needed to be arranged."

Common Needs

Teachers tend to have different classroom styles, and students have different learning styles as well. When styles mesh poorly, the student's work may suffer. The teacher normally takes the lead in correcting matters, and this principle applies to the student with a disability as much as to any other.

Any class may include students who are unable or too shy to speak up or ask questions easily. Shyness in a student with a disability may be compounded for various reasons. With students who are deaf, for example, hesitancy to speak up may be related to prior ridicule of the way their voices sound or the fear that they will be unable to understand the teacher's reply. The teacher can help by involving the student at appropriate times. It is a good teaching technique to encourage all students to participate actively in class. The practice benefits students and helps teachers monitor their progress.

Many students like to review subject matter before it is taught in lecture, recitation, or discussion sessions. Thus, it is helpful to make syllabi and other course materials accessible to all students as far in advance as possible. It is especially helpful to students with disabilities who may prefer to rely particularly on advance preparation and organization. Timely explanation of course requirements and objectives is extremely helpful not only to students with disabilities but to all students and facilitates collaborative work for lecture and in the laboratory.

Lecture/Discussion Techniques

Teachers who are careful about their techniques in lecturing and facilitating discussions are likely to be helping all of their students, but good technique is particularly valuable to students with disabilities. The governing principle is to speak and gesture as clearly and specifically as possible. Beyond that, the utility of various elements of good technique depends on whether the student is totally blind or deaf or has partial sight or hearing.

Mobility Impairments. Orthopedic disabilities usually do not require special awareness of classroom communication techniques. However, ensure that students in wheelchairs can position themselves in a location that provides in-class participation and a clear view of the instructor and visuals.

Visual Impairments. Teachers sometimes call on students by pointing, but students who are blind should be referred to by name. The practice is sound for any student. Similarly, the teacher can help students with impaired vision by referring to material on the blackboard by name. For example, one would say "benzene," not "this compound"; one would say "from 20 degrees Celsius to 40 degrees Celsius," not "from this temperature to that." It is also of great value to understanding when reading technical material to a blind person to follow the precepts in *Handbook for Spoken Mathematics* (8).

Students with impaired vision have their own ways of learning from graphics; the use of raised-line drawings is one such method[1] (Sources of Information, p. 37) (18). Still, the student can learn from graphics presented in class if the material is described carefully. Such material is best described in a consistent fashion—for example, clockwise or left to right. Students who are blind find it useful to have access to molecular models of structures discussed in lectures.

Hearing Impairments. Students who are deaf or hard-of-hearing depend on visual cues to follow classroom proceedings. Teachers can help by keeping their faces fully visible to the class when speaking, and by first ensuring eye contact when addressing the student.

The deaf student who is speech reading (lip-reading) or watching an oral or sign-language interpreter cannot simultaneously take notes, read written material, or watch a demonstration, film, or videotape. Increasingly, videotapes are being closed-captioned; that is, the captions are invisible unless activated by a decoder. The Television Decoder Circuitry Act of 1990 requires that all 13" or larger TV sets manufactured after July 1993 have a built-in decoder, which will simplify the use of closed-captioned materials.

Without an interpreter, neither deaf nor hard-of-hearing students can follow what other students are saying if remarks come from the back of the classroom. The teacher can help in several ways: by passing out printed material before class; by inserting appropriate pauses during demonstrations; by repeating questions asked by other students; and by summarizing classroom discussion on the blackboard at logical points. These practices can be useful to all students. Because many scientific terms do not have signs in sign language,[2] students with hearing impairments can benefit from seeing new terminology on the blackboard or on overhead transparencies. In discussion sessions, the teacher can help to keep the deaf student abreast by controlling the pace of the discussion. Allowing only one student to speak at a time, again, can benefit the entire group. *See Figure 1.*

Although the above accommodations may sound complicated to a teacher who has never considered them before, they are not difficult to implement.

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[1]The following is a simple, do-it-yourself technique for making raised-line drawings. This cheap, quick, and efficient method can be used by a lab assistant or anyone who is interested to clarify lecture material or diagrams for blind students.

Materials needed:
- tabletop or hard, flat surface
- thin sheet of rubber, leather, Naugahyde, or any pliable surface
- thick paper
- tracing wheel

Lay a thin sheet of pliable material on a hard, flat surface. On top of this, place a piece of thick paper. Sketch in ink or in pencil the mirror image of the desired drawing onto the paper, or photocopy the diagram onto thin, translucent paper and turn over before placing on the rubber surface. Firmly trace over the lines with a tracing wheel. Turn the paper over and you will have a raised line drawing.

[2]The Technical Sign Project Staff at the National Technical Institute for the Deaf is currently collecting, evaluating, and recording signs for scientific terms, including chemistry (p. 33).

Special Arrangements

Special classroom arrangements for students with disabilities can be worked out by teacher and student. As noted earlier, such arrangements are best made before the semester begins. Seating plans, for example, are important to students with hearing, visual, and orthopedic disabilities. Some students may need note takers or classmates who are willing to share their notes. They may wish to have photocopies or carbon copies of sets of

Figure 1. Group Communication Techniques

The deaf person should sit near the speaker.
Use visual aids to supplement a presentation.
Avoid standing in front of a light source.
Face the deaf person. Do not speak while writing on the chalkboard.
Provide new technical vocabulary in advance.
Make a special effort to clarify vital information.

Based on material provided by, and used with the permission of, the National Technical Institute for the Deaf

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notes taken by several students to compensate for individual habits in note taking (63). Other students may need oral or sign-language interpreters or may ask permission to tape lectures.

Teachers can help in several ways. They can help find volunteers to take or share notes. They might agree to make their own notes available to the entire class or offer to allow their classes to be taped with the provision that the tapes are for personal use only. Teachers can take the lead in creating an accommodating and welcoming climate in the classroom. Teaching assistants, where available, can also be helpful; sometimes students with disabilities may consider them more approachable than the teacher.

Many schools have an office that provides and coordinates support services for students with disabilities such as financial support for equipment or special services, and many state vocational rehabilitation agencies pay for some support services. Disabled Student Service Offices at colleges and universities vary in the services they can provide to students. The school offices should assist in obtaining the NSF and NIH facilitation awards mentioned in the introduction.

State Vocational Rehabilitation Offices also have varying rules about what financial assistance or technology they will provide. Students must check with the appropriate agencies in the state where the school is located to find out what kinds of assistance they can expect and what the school itself is obligated to pay.

In meeting these special classroom needs, it is the disabled student's responsibility to arrange for some of the required services. Such services might include the transcription of tapes for deaf students or the conversion of printed course materials into Braille, large print, or tape and the conversion of diagrams and graphics into raised-line form for blind or visually impaired students. Recording for the Blind converts printed text materials free, and loans the recordings of computerized books in disk format that provide access through Braille or speech output to blind and print-impaired persons (p. 39).

Students who are mobility impaired will need wide passageways in classrooms. They may or may not use computers for note taking and written reports and exams. Work or classroom spaces may need to be made more accessible to students who use wheelchairs.

The instructor should provide for the evacuation of mobility- and vision-impaired students from the building during fire drills.

Special consideration is often needed for students with speech impairments that prevent them from giving oral reports or answering questions in class. Also students with intermittent or variable disabilities such as muscular dystrophy, multiple sclerosis, or arthritis may require accommodation in both the classroom and laboratory.

Learning disabilities such as dyslexia can make reading print text difficult for the student and may require special classroom arrangements. For example, two routine accommodations are providing books-on-tape (p. 39)

and allowing additional time or alternate formats for exams as for students with other disabilities (ACE/HEATH, p. 30). Learning disabilities need not deter students with an interest and ability in science and engineering. Discussion of the "hidden" learning disability and strategies of coping with it by college students among others as well as an extensive listing of resources are included in *Succeeding Against the Odds–Strategies and Insights from the Learning Disabled* (62). The National Center for Learning Disabilities (NCLD) also offers information, referral, advocacy, and outreach for individuals with learning disabilities (Sources of Information, p. 34).

Another source of assistance with both special and general needs is the chemical fraternity, Alpha Chi Sigma, which has developed a service program for students of chemistry with disabilities. If there is a chapter on campus, its members can be called on for advice and for help of particular kinds, such as reading to blind students, converting diagrams and graphics into raised-line drawings, or administering examinations (Sources of Information, p. 28).

Testing & Evaluation

Administering tests to students with disabilities may require a degree of accommodation by the teacher. Experienced students who cannot take written examinations in the usual manner will have worked out an effective alternative. The inexperienced student may need to settle on a mutually satisfactory method with the teacher. The handbook *Post Secondary Educational and Career Development: A Resource Guide for the Blind, Visually Impaired and Physically Handicapped* published by the National Federation of the Blind (p. 33) is very helpful for inexperienced students. Arranging for special equipment or assistance, again, is the student's responsibility.

Special conditions may make it necessary to test disabled students orally or with the assistance of a reader/writer. However, disabled and able-bodied students often can take tests at the same time and place by using measures that include:

- *Putting tests and/or answers on tape or in Braille*
- *Using talking calculators with an earplug*
- *Using a typewriter or writing guide*

Various contingencies must be planned for. Some visually impaired students, for example, may need paper of nonstandard size for tests. Local societies for the blind often will convert tests into Braille, but may take one or two weeks to do so. Also, because the language of chemistry is not purely descriptive, care must be taken to see that it is converted into Braille accurately and completely. Here, a graduate student or advanced undergraduate can help by checking the translation with the aid of a Braille reader ahead of time.

Students who became deaf before they learned to speak may sometimes have difficulty expressing themselves. This is largely due to the difficulty of learning to read and write a language they've never heard; English is a second language for some deaf students. In grading tests, therefore, care must be taken to distinguish the student's grasp of the subject matter from disability-related writing deficiencies. Deaf students may not follow all of the post-examination discussion in class. The teacher can be helpful by taking extra care with comments written on the student's examination paper.

Students who use special methods to take tests may need extra time. The amount of extra time that can reasonably be permitted must be determined by the teacher. The circumstances will vary from student to student and method to method, and teachers encountering the situation for the first time may wish to consult the student's previous teachers or colleagues with pertinent experience. The most important person to consult is the student, who is the best source of information on how he or she can demonstrate knowledge of the course material most effectively. This is a time when a frank discussion between teacher and student can be extremely important.

Students with learning disabilities may also need extra time as well as extra scratch paper and sometimes enough extra space to write answers.

The critical need in testing and otherwise evaluating students with disabilities is to measure their performance on the same scale as the performance of other students. Special methods, separate rooms, and time allowances, where permitted, must be handled so that the student is evaluated under circumstances that, except for the disability, are equivalent to those imposed on other students.

Computers & Teaching Chemistry

General Considerations

The introduction of the microcomputer along with versatile and easy-to-use applications software and the availability of electronic input and resources have made computer technology increasingly useful to students, faculty, and practicing chemists. For all chemists the computer has become an important tool in the research and analytical laboratory for use in conjunction with the rapidly evolving instrumentation and for computational chemistry. The use of the personal computer for molecular drawing and modeling has become as common as its use in reporting, managing, and communicating chemical information. For students with disabilities the computer has become the necessary medium in acquiring data in the laboratory as well as preparing for work in many fields related to chemistry. In order to use this tool effectively, however, some students with disabilities must overcome barriers to computer access.

The vast expansion of chemical information in computer databases has greatly enhanced access by chemists and students with disabilities. All of *Chemical Abstracts* since 1967 as well as an extensive list of the chemical literature is available on-line through Scientific Technological Network (STN), a part of the ACS Chemical Abstracts Service. Access through a modem and appropriate software is obtainable from STN at academic rates as are other services such as DIALOG (p. 29).

Some modifications of computer layout and support services can assist individuals with a variety of disabilities. For example, many users can benefit from flexibility in the positioning of monitors, keyboards, tables, bench tops, input instruments, and documentation. Signs indicating the availability of accessible equipment in the work area and documentation describing its use and adequate support personnel also benefit many people. The expansion of networking services on campuses also benefits students with disabilities, giving them access to a wider variety of resources, providing an efficient communication method, and reducing the necessity to move about the campus (49).

Computers can be adapted to provide access to individuals with a variety of disabilities. A wide selection of products can be found in directories from Apple, Closing the Gap, the Trace Center, and IBM (p. 35). When selecting appropriate products, criteria should include compatibility, transparency, flexibility, ease of use, cost, warranty and maintenance, and vendor support. Some solutions to specific access problems are described below.

Computer Access for Individuals with Mobility Impairments

In addition to convenient wheelchair accommodation (p. 19), access for individuals with mobility impairments can be enhanced by plugging all computer components into power outlet strips with readily-accessible switches,

which allows equipment to be turned on and off more conveniently by disabled users.

Some individuals with physical disabilities have little or no use of their hands, making input to the computer through a standard keyboard difficult or impossible. Individuals who have use of one finger, a mouth- or headstick, or some other pointing device can control the computer by pressing keys with the pointing device. Sometimes repositioning the keyboard and monitor can enhance accessibility. Hardware and software switching devices can be used to lock the SHIFT and CONTROL keys; they allow sequential keystrokes to access functions that normally require two or more keys to be pressed simultaneously. Keyboard guards (solid templates with holes over each key to assist precise selection) can be used by those who lack fine motor control.

Some hardware modifications completely replace the keyboard and/or mouse. Expanded keyboards (larger keys spaced farther apart) can replace standard keyboards for those who lack fine motor control. Mini-keyboards provide access to those who have fine motor control but lack a range of motion great enough to use a standard keyboard. A track ball or other input device can replace the mouse.

For those with more severe mobility impairments, scanning and Morse code inputs are available. In each case, special switches make use of at least one muscle over which the individual has voluntary control, e.g., head, finger, knee, or mouth. In scanning input, a light or cursor scans letters and symbols displayed on the screen or an external device. Individuals activate switches to make selections. In Morse code input systems, users input Morse code by activating switches (e.g., a sip-and-puff switch registers a dot with a sip and a dash with a puff). Special adaptive hardware and software translate Morse code into a form that the computer understands so that standard software can be used.

Voice input provides another option for individuals with disabilities. Speech recognition systems allow users to control computers and provide input by speaking words and letters. Systems are "trained" to recognize specific voices.

Special software can further aid the mobility impaired. For example, word prediction software can anticipate entire words after several keystrokes thereby increasing the input speed of those with mobility impairments. Abbreviation expansion (macro) and word prediction software can also reduce input demands for commonly used text and keyboard commands. Disk guides can assist with inserting and removing diskettes; a dedicated hard disk and/or network access can eliminate or reduce the necessity to do so. On-screen help can provide efficient access to user guides for those who cannot turn pages of a book.

In addition, students who have access to networks can communicate with other people and access electronic resources such as *Chemical Abstracts* and journals through on-line services such as STN.

Computer Assistance for Individuals with Visual Impairments

Computing facilities can assist visually impaired users by providing instruction sheets, signs, and labels on equipment and support materials in large print and Braille. Anti-glare screens can make screens easier to read. In addition, special equipment and software can enlarge text and graphics on monitors and printers. Special software can also reverse screens from black on white to white on black for individuals who are light sensitive.

Voice output can be used to read screen text to blind users. Refreshable Braille displays allow word-by-word translation of the screen into Braille on a display area where vertical pins move as the text is scanned. Braille printers provide output. With the proper combination of software, graphics such as organic chemical structures and bar and line graphs can be printed in raised dots or Braille (p. 38).

Scanners with optical character recognition (i.e., reading machines) can be used to read printed materials and store them electronically on computers where they can be read using voice synthesis or printed in large print or Braille. Once on voice tape, a voice indexing technique can be used to search and locate specific information quickly (p. 35). Such systems can provide independent access to abstracts, journals, syllabi, and homework assignments. Some hardware and software vendors provide Braille, large print, or ASCII versions of their documentation to support visually impaired users.

Computer Use by Individuals with Hearing Impairments

Although hearing-impaired individuals face relatively minor barriers to computer use, some benefit from visual alternatives to audio output provided by some software packages. Additionally, portable computers with voice synthesis can be used as communication devices so that hearing-impaired persons without speech can participate in group discussions. Telecommunication is a particularly powerful tool for students with hearing impairments. With a computer and communications hardware and software they can independently access electronic bulletin boards, databases, electronic mail, discussion groups, and on-line services.

Computer Use by Individuals with Learning Disabilities

Quiet work areas and ear protectors may assist students who are hypersensitive to background noise. In addition, some students with learning disabilities who have difficulty processing written information can benefit from completing writing assignments and tutorial lessons with the aid of a computer. Learning-disabled students may benefit from the use of spell checkers, thesauruses, grammar checkers, and word prediction programs (software that predicts whole words from fragments). Macro software can

reduce the necessity to memorize keyboard commands and can ease the entry of commonly used text. Some learning-disabled students find that large print displays and voice output can compensate for some visual and reading difficulties.

For students who find it difficult to read, information in an electronic form that can be used by a voice synthesis device can be very helpful. Tapes and diskettes for students with learning disabilities are available from Recording for the Blind (Sources of Information, p. 39). There are several "reading machines" that provide an alternate way to read printed documents such as books, magazines, manuals, letters, memos, and computer printouts (Sources of Information, p. 38).

In the Laboratory

Laboratory experience is essential for students of an experimental science like chemistry, and the student with a disability is no exception. Some disabilities may restrict the student's laboratory activities more than others, and the level of involvement desirable and necessary must be determined through discussion with the student on an individual basis. Students whose efforts in the laboratory are sharply restricted by a disability are not necessarily barred from careers involving laboratory work. Many successful chemists direct experimental programs without the need to perform laboratory manipulations themselves. It should be noted also that many chemists with disabilities work in the lab in the same manner as scientists who do not have a disability, with few or no special accommodations.

General Considerations

Certain general considerations apply to all students with disabilities entering a laboratory course. It is important, for example, to involve the laboratory instructor from the beginning. The teacher can do this by scheduling a conference with the instructor and the student before lab work begins and by seeing to it that the two remain in regular contact. It is customary in some lab courses to pair students as partners or to work collaboratively in groups. In this case, it is important to help the student locate a congenial lab partner or group and to check occasionally to be sure everything is working well. In certain situations, employment of a full-time laboratory assistant enables the student with a disability to gain the most educational experience. Selecting the laboratory is the joint responsibility of the student and the instructor.

If a student needs extra time to complete a lab assignment, the teacher should try to be flexible. Extra time might be available in a Saturday section, or a student might enter an additional lab section during the week or start early or stay late in the regular section. It is best that student and teacher agree on the amount of extra time that is reasonable so that time does not become an issue when the student's work is evaluated.

Some physical modifications in the lab might be necessary. They are discussed briefly below in terms of specific types of disabilities. (For more detailed information, see Sources of Information.) Whatever modifications are desired may require ingenuity on the part of the small school or department with limited resources (65).

Students with Mobility Impairments

The student with impaired mobility needs to have easy access to equipment including computers, materials, safety devices, and other services such as restrooms, ramps, elevators and telephones, and accessible doors and exits. The student also needs enough aisle space to permit lateral movement and maneuverability. Positioning a wheelchair parallel to the lab bench and

fume hood is generally restrictive, although some students prefer it. Ideally, a workbench should have an opening underneath which allows a wheelchair-using student to be closer to the work surface (14).

Every teaching laboratory should have at least one adapted workbench. The basic requirements for a laboratory work station for a student in a wheelchair have been described (26). *See Figure 2.* Briefly, they are:

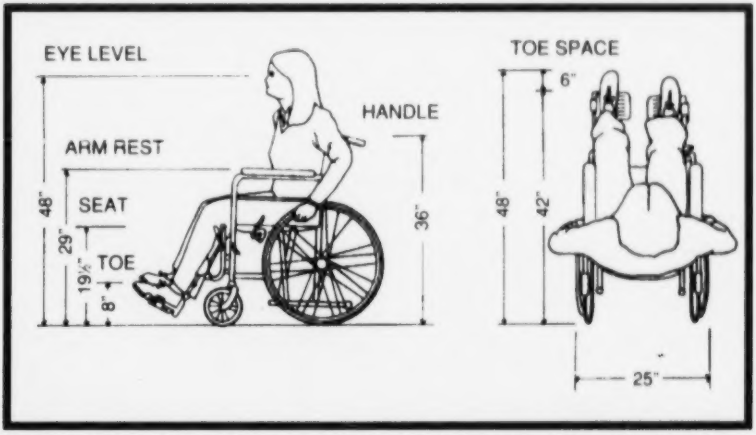
- *Work surface 30 inches from floor*
- *29-inch clearance beneath the top to a depth of at least 20 inches and a minimum width of 36 inches to allow leg space for the seated individual*
- *Utility and equipment controls within easy reach*
- *Clear aisle width sufficient to maneuver a wheelchair; recommended aisle width is 42 to 48 inches*

Should the aisles be too narrow, a lab station can be set up at the end of the bench or a portable station can be designed or purchased and positioned as desired. Another alternative, if the student can transfer from the wheelchair, is to design a more maneuverable chair for use in the lab only. Two such designs that have worked well are:

- *An ordinary armless chair secured to a platform that moves on casters. To move, the rider pushes against the floor with rubber-tipped canes (46). See Figure 3.*
- *An adjustable-height wheelchair made from an old office chair, a set of wheelchair wheels, and hydraulic truck jack with a 6-inch lift (58). See Figure 4.*

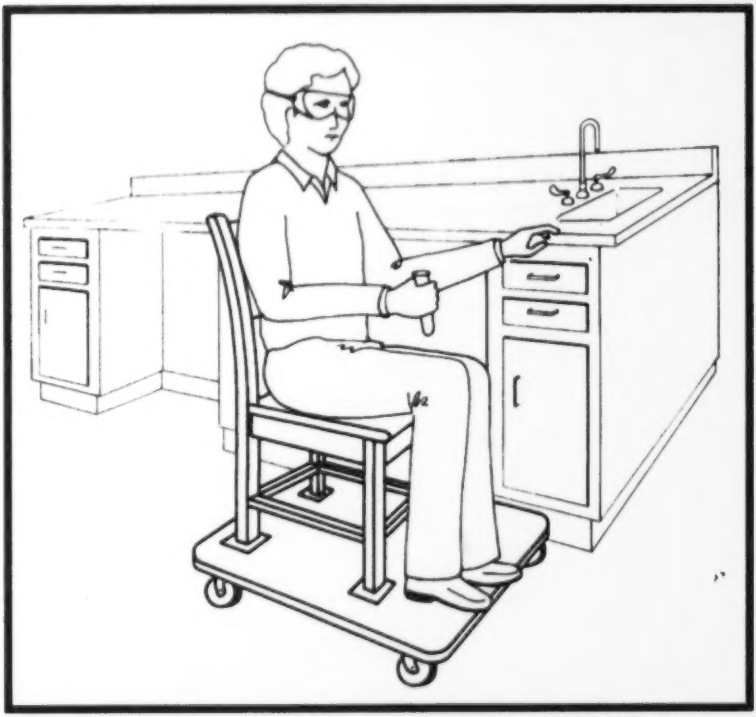
Compared to a wheelchair, these homemade designs permit good mobility around the lab, increased mobility at the bench, and increased accessibility to the bench top. Supplies and equipment can be moved

Figure 2. Standard Wheelchair Dimensions



Based on material provided by, and used with the permission of, the Association of Physical Plant Administrators of Universities and Colleges.

Figure 3. Platform Chair



Based on material provided by, and used with the permission of, the Association of Physical Plant Administrators of Universities and Colleges.

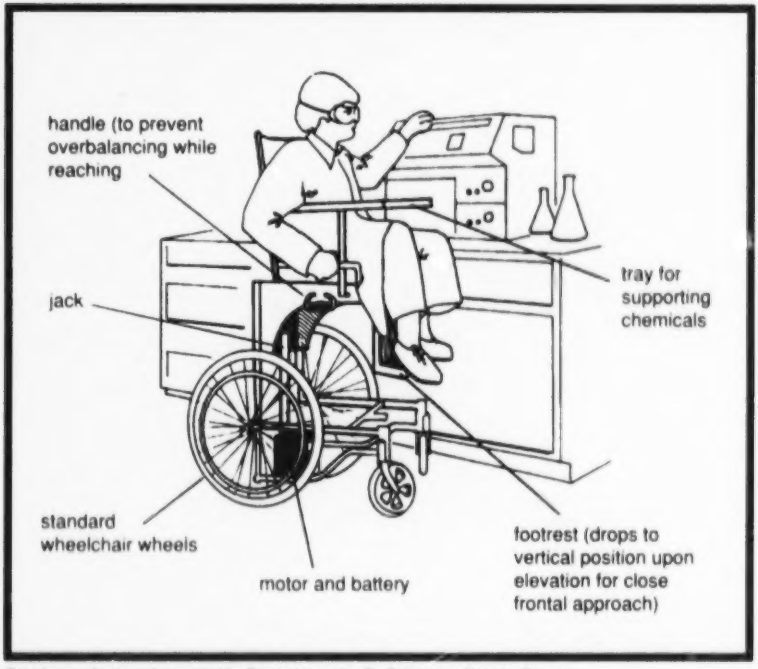
around the lab on the chair-and-platform device, which provides a flat, steady surface. The adjustable-height wheelchair may include a tray that can be snapped onto the chair's arms to carry equipment such as flasks and crucibles, leaving both hands free to operate the chair. Mobility and accessibility at the bench can also be enhanced by constructing a platform to raise the student to a height more compatible with the height of the bench top and by modifications to the bench itself, such as pull-out shelves.

One chemist who uses a wheelchair performs most experiments on a standard vacuum rack. This 22-inch high, 12-inch deep workspace provides the vertical access required by a seated individual for doing titrations, distillations, and column chromatography (41).

The laboratory as a whole can be made more accessible to students with impaired mobility by making various modifications:

- *Adjustable-height storage units and special-equipment work space*
- *Pull-out or drop-leaf shelves or counter tops for auxiliary use; for example, shelves at lap-board height for holding instruments to be used by students in wheelchairs*

Figure 4. Adjustable-Height Wheelchair


handle (to prevent overbalancing while reaching
jack
tray for supporting chemicals
standard wheelchair wheels
motor and battery
footrest (drops to vertical position upon elevation for close frontal approach)

Based on a photograph provided by Brock University, St. Catharines, Ontario, Canada.

- *Single-action lever controls or blade-type handles rather than knobs for students with impaired manual dexterity*
- *Flexible connections to electrical, water, and gas lines for students with limited reach (i.e., in a wheelchair)*
- *Alternative means of storage, such as a portable lazy Susan or a storage cabinet on casters*

Students whose disabilities affect the use of both upper and lower limbs may need an assistant to perform experiments under the student's direction. The student should be able to observe the data acquisition as well as direct the experiment. This approach for the quadriplegic student is much the same as that described for the student who is visually impaired in the following section.

The above provisions for making a laboratory more accessible to students with impaired mobility have been used successfully by various disabled scientists. Again, however, students' needs tend to be individualized, so accommodations are best considered on a student-by-student basis. Also much of the low-tech occupational therapy equipment and devices fashioned for ADL (Activities for Daily Living) and independent activity in the home would be equally useful in the laboratory.

Students with Impaired Vision

Many students with severe visual disabilities have mastered chemical laboratory work. Blind students who have been accommodated in the laboratory testify that the work is not only educational, but enjoyable; for them, the hands-on experience was vital. Some students with impaired vision have completed laboratory sessions, possibly using only a magnifying glass or relying informally on a partner or nearby classmate to read numbers or confirm observations. Other students with impaired vision require more help. The degree of disability determines the policy to be adopted.

Computer-interfaced devices (included in the list below) are one way to provide an intermediate level of accommodation that allows blind students to work in the laboratory more independently.

Some students who are visually impaired may require a full-time laboratory assistant. In schools that allow or use the lab partner system, the instructor should assist the student in finding a suitable partner. The assistant should not be taking the course simultaneously, but it is useful to have someone who has done so and knows the equipment and terminology. The student does the thinking and directs the assistant to give a response. It is helpful for the student to have the opportunity before or during the lab session to feel and visualize how the equipment is set up. The student should be encouraged to be as independent as possible. In some cases, it may be necessary for the assistant to manipulate the equipment. The instructor should confirm that the assistant functions properly. When questions arise the student should take them up directly with the instructor, not through the assistant, and vice versa.

Blind students negotiate best in familiar surroundings. Even though they may never need to visit remote parts of the laboratory, they should familiarize themselves with the entire setting. A short time with the lab instructor locating sinks, reagent shelves, hoods, safety showers, and the like will orient the student and help to determine the best place to work. The student will find the exits, learn the bench configurations, memorize the positions of the utilities, and so forth. The laboratory becomes familiar and comfortable. This orientation session can also be used to explain the safety rules and outline fire drill and other procedures. It is also the time to explain what locations in the laboratory pose the greatest potential hazards.

Blind students who have guide dogs may decide not to take them into the laboratory. A small office nearby or an out-of-the way spot at the far end of the balance room might be an ideal place to leave a dog. Guide dogs are obedient and accustomed to waiting.

Students with partially impaired vision may require no special laboratory assistance at all. One lab station may be better than another because the lighting is better, for example. Some students with partial sight may need larger letters on reagent bottles, a magnifying glass to read burettes, or a larger notebook than prescribed for the course. Such requirements are easily met; usually the student takes care of them.

The development of special equipment to facilitate laboratory work for students with impaired vision is a relatively new area of research, but progress is being made rapidly. References to such equipment are found under "Teaching/Laboratory Aids" in the Sources of Information (p. 35) (59). There is an excellent illustrated review of this type of special equipment presently available for use in high school teaching laboratories (68). Examples of equipment now available include:

- *Voltmeters and multimeters with audible readout*
- *Talking thermometer*
- *Light probes (used as part of readout devices; it emits a tone that increases in pitch proportionally to changes in light intensity) (68)*
- *Liquid-level indicators*
- *pH meter (65)*
- *Talking balance (24)*
- *Spectroscope (35)*
- *Electronic calculators with Braille printout*
- *Braille labelers*
- *Braille rulers and meter sticks*
- *Braille thermometer*
- *Laboratory glassware with raised numbers*
- *Sandpaper labeling for hazardous chemicals*
- *Spoons with sliding covers*
- *Electronic calculators with both voice and Braille output*
- *Microcomputers equipped with interfacing cards to control a variety of instruments*

Students with Impaired Hearing

Unlike visual and orthopedic disabilities, impaired hearing is not a visible disability unless one sees the student wearing a hearing aid or using sign language. Some deaf students do not speak at all. In general, impaired hearing has little effect on the ability to work in a chemical laboratory. Except for the installation of visual warnings in addition to normal audible warnings, and emphasis on good communications, students who are deaf or hard of hearing have few special needs in a chemistry laboratory.

Students who are deaf sometime face a social barrier in that deafness impedes communication with other students. The teacher can be helpful by assisting in finding a sensitive lab partner or assistant when a partner is needed.

Laboratory Safety

Safety in the chemical laboratory has received a great deal of attention over the years and has been the subject of numerous publications (12, 13). Special safety measures for students with disabilities are not usually considered in such documents, but logically should be based on the precautions established for all students. From this perspective, any extra measures entailed by the presence of students with disabilities comprise a small increment in the body of general safety requirements and practices.

There is no reason to assume that students with disabilities will be less careful or will pose a greater hazard than other students in the laboratory. This argument was borne out by a study of 1400 disabled employees at Du Pont (61): "Du Pont's experience has proven that disabled workers are safe workers."

Federal standards for occupational safety in laboratories are the province of the Occupational Safety and Health Administration (OSHA) in the US Department of Labor. Consequently, OSHA was asked for its position on students with disabilities and laboratory safety. Dorothy L. Strunk, Acting Assistant Secretary of Labor for OSHA, responded:

> *The Occupational Safety and Health Administration sets and enforces workplace safety and health standards intended to prevent occupational injuries and illnesses among American workers. As you know, students do not fall under the protection of the Occupational Safety and Health Act of 1970. Thus, OSHA regulations do not apply to students—with or without disabilities—in classrooms or laboratories.*
>
> *Nevertheless, the agency recognizes the importance of providing equal opportunity in education to disabled students by enabling access to laboratories and establishing appropriate measures to ensure the safety of all students within the laboratory. OSHA standards may offer valuable guidelines for determining suitable protective measures. In addition, local OSHA offices and state-based, OSHA-sponsored safety and health consultation programs can be helpful sources for further information on protecting students in laboratories.*

Safety professionals are one possible source of up-to-date information on chemical and laboratory safety. The school that does not have a safety professional might obtain help from one at another school or a nearby laboratory. Such individuals should be knowledgeable about regulations and practices and be able to define the reasonable precautions required of the teacher in particular circumstances. Not all safety professionals, however, can be expected to be knowledgeable about good safety practices for students or scientists with disabilities, and it can be helpful to clarify this point with them. Information on chemical safety can be obtained from the ACS Committee on Chemical Safety, which is designed to steer callers toward the proper resources (p. 29) (12, 43).

There is certainly a need to enforce good laboratory practices and sensible safety measures for students. The suggestions that follow apply to all students; those that are oriented particularly toward students with disabilities are indicated by asterisks (*). This is not an attempt to provide a comprehensive discussion of lab safety; complete consideration of general laboratory safety practices can be found in the ACS safety manual (p. 29) (12).

1. Always discuss procedures and any special safety considerations with the students before allowing an experiment to begin. Safety rule sheets should be available in alternate formats such as Braille or large print.

2. Arrange and discuss evacuation plans for fire and other emergencies. Review such plans periodically.

3. Give all students safety quizzes or safety-rule sheets to read, sign, date, and return to the instructor. Go over these procedures and rules with the students. Use open-ended questions to obtain clarification.

4. Post copies of the safety rules at several locations in the lab and give a copy to each student.

**5. Give the student with impaired vision an opportunity to become familiar with the laboratory before the first session. The student can then participate in the safety-orientation program with little trouble and will already know the locations of exits, showers, and extinguishers.*

**6. Discuss and resolve individual limitations with the student with impaired vision who has no full-time lab assistant. Can the student read labels? Are the labels big enough? Are Braille labels or raised-letter reagent bottles available? Consult with the student as to whether there are any operations too risky for the student to handle alone.*

7. Do not use the shower or eye wash areas for temporary storage or place anything that would interfere with ready access to safety equipment such as fire extinguishers.

8. Keep all aisles and all exits including emergency exits clear of obstructions.

9. Ensure that reagent containers are labeled clearly and returned to their shelves after each use. These shelves should be readily accessible to students with disabilities.

**10. Assign the student with impaired mobility to a lab station on an outside aisle and close to an accessible exit, if possible. Students with impaired hearing should have lab stations that afford an unobstructed view of the instructor.*

11. Insist on the use of splash-proof goggles at all times in the lab.

12. No student should pour from large containers of concentrated acids or bases. Reagent containers too large to be easily grasped by one hand have no place in any instructional chemistry laboratory.

**13. Students, including those with impaired vision or poor manual coordination, are strongly urged to wear rubber gloves when working with harsh chemicals or those readily absorbed by the skin. Disposable, lightweight gloves are available that will permit the student to manipulate equipment.*

**14. All students should wear plastic or rubber aprons when working with chemicals in order to protect their clothing. Students who use wheelchairs or those who have no sensory perception in the lower half of the body should be advised of the importance of protecting their laps with a heavy rubber apron while working with chemicals.*

15. Employ the buddy system in the lab for assistance in emergencies.

16. Prohibit all students from working in the lab alone. Although it is a reality in some laboratories, ACS does not advocate the practice of graduate students working alone late into the night to finish or monitor experiments.

**17. Accessible and usable eye washes should be located near the disabled student's work station. The American National Standards Institute requires that eye and face wash units and emergency showers be reached within 10 seconds (ANSI Z358.9.1-1990, Standard Requirements, 4.6.1 and 7.4.4), which means that the work station should be within a few meters of these safety installations.*

18. Equip laboratories with emergency lighting (using batteries or another power supply) in case of power failure. Emergency lighting is particularly needed for deaf students as they rely on visual cues more than do students who can hear.

**19. When a deaf student is working in a lab, it is helpful to have available equipment with lights or other visual means of indicating on and off status, although most equipment can be monitored easily by touch. Alarm systems also should be visual, with flashing lights. Expensive changes to equipment are seldom needed for deaf students, however. For example, they can feel when a timer sounds if they hold it in their hands.*

20. Ensure that combustible gas supplies from the gas jets on the benches contain odorants. Students with impaired hearing may not hear the sound of an open gas jet, although they will be more inclined to check visually than will students who can hear.

**21. Lightweight fire extinguishers should be provided for mobility-impaired students, but all students should be instructed in the use and limitations of fire extinguishers and in fire drill procedures. Lightweight dry chemical fire extinguishers are often the only kind a mobility-impaired student can handle and are preferred as almost all dry chemical fire extinguishers have a greater effective range and extinguishing capacity than the carbon dioxide extinguishers usually provided in laboratories. For example, a fully charged 5 lb. carbon dioxide fire extinguisher, the minimum required size, weighs 14 lbs. and has a 5B rating. It is good for a fire of approximately 5 square feet of burning liquid. On the other hand, a 5 lb. dry chemical fire extinguisher can weigh as little as 8½ lbs.; it has an aluminum rather than a steel shell and carries a 40B rating. This means it is eight times more effective than a 5 lb. carbon dioxide extinguisher. Also, if a dry chemical fire extinguisher weighing 8½ lbs. has both an A and a B rating, it is also equal to 2½ gallons of water, which gives it the same extinguishing ability as an ordinary 2½ gallon water extinguisher weighing 27 lbs.*

Closing Comment

The preceding discussion and the following sections—Sources of Information and Bibliography—represent a considerable volume of material on teaching students with disabilities. Of all this material, two salient points bear repeating for teachers of chemistry. One is that students, disabled or not, tend to have individualized needs and learn best when taught on that basis. The other is that students with disabilities largely have made the extra effort to get where they are and wish to be judged against the recognized standards of academic achievement.

There is a third and overriding point: the need to recognize and so learn to correct the deep-seated attitudes that long have denied many young people with disabilities the opportunity to pursue an education and career of their choice. Society tends to equate a disability with reduced abilities overall. In fact, a disability is but one determinant—and by no means the most important—of an individual's capacity. By recognizing that point, teachers and others involved in the educational process will enhance the utility of this manual to themselves and to the students whose futures they influence.

SOURCES OF INFORMATION

RESOURCES AND INFORMATION ON ADA

Americans with Disabilities Act Handbook
Equal Employment Opportunity Commission
1801 L Street, N.W.
Washington, DC 20507
(800) 669-EEOC (Voice)
(800) 800-3302 (TDD)

Regulations, Technical Assistance, and Enforcement for Titles II and III
Civil Rights Division
Office on the Americans with Disabilities Act
U.S. Department of Justice
P.O. Box 66118
Washington, DC 20035-6118
(202) 514-0301 (Voice)
(202) 514-0383 (TTD)

ADA Accessibility Guidelines (ADAAG) Uniform Federal Accessibility Standards (UFAS)
Architectural and Transportation Barriers Compliance Board
1111 18th Street, N.W., Suite 501
Washington, DC 20036
(800) USA-ABLE (V/TDD)

Telecommunications
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554
(202) 634-1837 (Voice)

Transportation
Department of Transportation
400 Seventh Street, S.W.
Washington, DC 20590
(202) 366-9305 (Voice)
(202) 755-7687 (TDD)

All documents available from these agencies are available in alternate formats: Braille, large print, audiotape, computer disc, and electronic bulletin board. To obtain materials in any of these formats, call (202) 514-6193.

ORGANIZATIONS INVOLVED IN EDUCATION OF STUDENTS WITH DISABILITIES

Alpha Chi Sigma Fraternity
2141 N. Franklin Road
Indianapolis, IN 46219-2497
(800) 252-4369; 1-800-ALCHEMY
(317) 357-5944

Alpha Chi Sigma, the national chemical fraternity, with 44 active collegiate chapters, has developed a service program to assist chemistry students with disabilities. The national chapter can be contacted for information about campus chapters.

American Association for the Advancement of Science (AAAS)
Project on Science, Technology and Disability
Directorate for Education & Human Resources Programs
Virginia W. Stern, Director
1333 H Street, N.W.
Washington, DC 20005
(202) 326-6630 (V/TDD)

AAAS is a major resource center promoting access to science for persons with disabilities. A resource group of over 1200 scientists with disabilities is available for consultation through AAAS. Available publications: *Resource Directory of Scientists and Engineers with Disabilities* (2nd edition, 1987); four booklets published in 1991, *Barrier-Free in Brief*: "Laboratories and Classrooms in Science and Engineering," "Access in Word and Deed," "Access to Science Literacy," and "Workshops and Conferences for Scientists and Engineers." *Investing in Human Potential: Science and Engineering at the Crossroads* (1991), by Marsha Lakes Matyas and Shirley M. Malcom (eds.), is available from AAAS Books, Dept. A37, P.O. Box 7513, Waldorf, MD 20604.

American Chemical Society
1155 16th Street, N.W.
Washington, DC 20036

a) ***Committee on Chemists with Disabilities***
Staff Liaison
(800) 227-5558
(202) 872-4438 (V/TDD)

The American Chemical Society Committee on Chemists with Disabilities' mission is to make all programs and activities of ACS available and accessible to persons with disabilities; to assist the removal of existing barriers, both physical and attitudinal, to the education and full employment of persons with disabilities; to facilitate the involvement of persons with disabilities in the chemical profession and in ACS activities; and to help prevent the creation of additional barriers.

b) ***Committee on Chemical Safety***
Staff Liaison
(800) 227-5558
(202) 872-4515

The American Chemical Society Committee on Chemical Safety has prepared a manual entitled "Safety in Academic Chemistry Laboratories" (13) for prudent practice in the chemical laboratory. Although written primarily for use in high schools and colleges, these guidelines can be adapted to practices in all laboratories using chemicals, including research, clinical, quality control, and development laboratories.

c) ***Chemical Abstracts Service —STN International***
2540 Olentangy River Road
P.O. Box 3012
Columbus, OH 43210-0012
(800) 753-4227

STN International, operated jointly by Chemical Abstracts Service in North America, FIZ Karlsruhe in Europe, and the Japan Information Center of Science & Technology in Japan, is a network of more than 130 databases in a broad range of scientific fields. Access through modem and appropriate software to chemical abstracts and chemical literature can be obtained at special academic rates.

American Federation of Teachers
555 New Jersey Avenue, N.W.
Washington, DC 20001
(202) 879-4561
(202) 879-4537 (Fax)

Publishes *Reasonable Accommodations: A Faculty Guide to Teaching College Students with Disabilities* (1988).

Assistive Device Center
School of Engineering
California State University—Sacramento
Sacramento, CA 95819-6027
(916) 278-6422

The Assistive Device Center maintains an Assistive Device Database, a collection of information on adaptive aids, bibliographic references, service agencies, and resource persons.

The Association of Higher Education Facilities Officers
(formerly Association of Physical Plant Managers, APPA)
APPA Publications, Dept. CAT
P.O. Box 1201
Alexandria, VA 22313-1201
(703) 684-1446

APPA publishes *Removing the Barriers: Accessibility Guidelines and Specifications* (1991) to help colleges and universities comply with the Americans with Disabilities Act (ADA). The book offers detailed information on the requirements for facilities to conform with the Act.

The Science Association for Persons with Disabilities
(formerly Science for the Handicapped Association)
Regional Science Center
Moorhead State University
Moorhead, MN 56563
(218) 236-2904

The Association promotes science for all students with disabilities. It publishes a newsletter containing bibliographic citations on science for persons with disabilities as well as descriptions of current research, conferences, and courses.

Association on Higher Education & Disability (AHEAD)
(formerly AHSSPPE)
P.O. Box 21192
Columbus, OH 43221-0192
(614) 488-4972 (V/TDD)

AHEAD is an international association of disability support service offices (DSSOs) from over 600 institutions of higher learning. AHEAD promotes information sharing through a bimonthly newsletter, a national database, conferences, and special interest task forces. It provides information on laws and testing accommodations for students with disabilities and publishes a newsletter, "ALERT."

AHEAD publishes an ADA Response Handbook, "A Practical Guide for Service Providers" to help service providers gather up-to-date information about the Americans with Disabilities Act. The handbook may be obtained at the above address.

Center for Multisensory Learning
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-8941

This organization has developed hands-on science materials, such as a Braille thermometer and Braille meter stick, for multisensory science experience for children with disabilities, including Science Activities for the Visually Impaired and Science Enrichment for Learners with Physical Handicaps (SAVI/SELPH). Also published "Disabling the Disabled: Discrimination in Higher Education," a 1979 report by Daniel Finnegan.

The Foundation for Employment & Disability, Inc. (TFED)
3820 Del Amo Boulevard, Suite 201
Torrance, CA 90503
(310) 214-3430
(310) 214-1413 (TDD)
(310) 214-4153 (Fax)

TFED is a nonprofit organization that develops and operates educational programs that foster employment opportunities for individuals with disabilities. It operates programs for students in grades K–12, for teachers, and for employers; one new program is "Scientists on Call," in which scientists with disabilities interact with students in elementary schools to help students and teachers learn about careers in science.

Foundation for Science and the Handicapped (FSH)
1141 Iroquois Drive, #114
Naperville, IL 60563
(708) 357-7908
Dr. S. Phyllis Stearner, Treasurer

FSH is an organization of disabled scientists that functions as a resource and advocacy group promoting access to science education and employment for persons with disabilities. FSH publishes a newsletter and has published a book, *Able Scientists—Disabled Persons: Careers in the Sciences* by S. Phyllis Stearner, PhD.

ACE/HEATH Resource Center
American Council on Education
One Dupont Circle, Suite 800
Washington, DC 20036-1193
(202) 939-9320 (V/TDD)
(800) 544-3284 (V/TDD)

HEATH is the national clearinghouse on postsecondary education for persons with disabilities. This is a program of the American Council on Education with funding from the U.S. Department of Education and it operates under Congressional legislative mandate to collect and disseminate nationally information about disability issues in postsecondary education. HEATH can provide information and referral on a wide range of topics involving students with disabilities. Single free copies of the following can be obtained from the Resource Center: a resource directory, "Access to the Science and Engineering Laboratory and Classroom" (1986); "How to Choose a College: Guide for the Student with a Disability" (3rd edition, 1991); "Career Planning and Placement Strategies for Postsecondary Students with Disabilities" (1991); "Barrier-Free in Brief" (1992).

Job Accommodation Network (JAN)
West Virginia University
809 Allen Hall
Morgantown, WV 26506
(800) 526-7234 (V/TDD)
(304) 393-7186

JAN can provide information about adapting a class or lab. Be prepared to explain the specific details of your situation.

Mobility International USA (MIUSA)
P.O. Box 3551
Eugene, OR 97403
(503) 343-1284 (V/TDD)

A membership organization that offers information and referral services on travel and international educational exchange opportunities for persons with disabilities. Publications include *A World of Options for the 90's: A Guide for International Educational Exchange, Community Service and Travel for Persons with Disabilities* by Cindy Lewis and Susan Sygall (1990).

National Council on Disability
800 Independence Avenue, S.W.
Suite 814
Washington, DC 20591
(202) 267-3846 (Voice)
(202) 267-3232 (TDD)

An independent federal agency charged with addressing, analyzing, and making recommendations on issues of public policy that affect people with disabilities. Publishes a free newsletter, "FOCUS."

National Organization on Disability (NOD)
910 16th Street, N.W., Suite 600
Washington, DC 20006
(202) 293-5950 (Voice)
(202) 267-5058 (TDD)
(202) 293-7999 (Fax)

NOD's Community Partnership Program undertakes activities to improve attitudes toward people with disabilities, eliminate physical barriers, and expand opportunities in education and employment.

National Science Teachers Association (NSTA)
1742 Connecticut Avenue, N.W.
Washington, DC 20009
(202) 328-5800
(202) 328-5340 (Fax)

NSTA is a national association that subscribes to the importance of equal access to science education for students with disabilities. NSTA has a standing committee to address issues in this area; a strong position statement regarding science for persons with disabilities; and numerous articles on persons with disabilities in four journals.

Sensory Access Foundation (SAF)
385 Sherman Avenue, Suite 2
Palo Alto, CA 94306
(415) 329-0430 (Voice)
(415) 329-0433 (TDD)

SAF educates consumers and employees on assistive technology most appropriate to a job. Also publishes a bimonthly newsletter, "Technology Update."

Technical Assistance Resource Center (associated with RESNA)
1101 Connecticut Avenue, N.W.,
Suite 700
Washington, DC 20036
(202) 857-1140 (V/TDD)

This is the national network of the Technology-Related Assistance for Individuals and Disabilities Act of 1988 (known as the Tech Act). The legislation gives grants to states to develop and implement a statewide program to assist persons with disabilities to understand and use assistive technology. This technology can be anything from a page-turner to a wheelchair or computer. The Center will refer you to the program closest to you.

Colleges & Universities

Colleges That Enable
By Prudence and Jason Tweed (1989), Park Avenue Press, Oil City, PA 16301
A listing of services provided for students with disabilities at 148 colleges.

Directory of College Facilities and Services for People with Disabilities
By C.H. and T.L. Thomas (1991), Oryx Press, Phoenix, AZ

The above publications give comprehensive listings of available services in colleges for students with disabilities. Just a few examples of colleges with good programs and services are given below.

College and Career Programs for Deaf Students
Center for Assessment and Demographic Studies
Gallaudet Research Institute
800 Florida Avenue, NE
Washington, DC 20002
(800) 451-8834 Ext. 5575 (V/TDD)
(202) 651-5575 (V/TDD)
(202) 651-5746 (Fax)
CADS-RAWLING@GALU (e-mail)

Describes postsecondary programs for deaf and hearing-impaired students.

Disability Services
Boston University
The Martin Luther King Center
19 Deerfield Street
Boston, MA 02215
(617) 353-3658 (V/TDD)

Over 200 students, staff, and faculty with various disabilities are in the mainstream of full campus life.

Disabled Student Services
University of California—Irvine
Irvine, CA 92717
(714) 856-7494

The Office of Disabled Student Services not only deals with about 250 permanently disabled students on campus but can provide help and advice to secondary school students and teachers.

Handicapped Student Services
Wright State University
Dayton, OH 45435

The Handicapped Student Services Office has had several years' experience in adapting lab courses for orthopedically and visually disabled students, mainly in the biological sciences.

Johnson County Community College
Special Services
12345 College Blvd.
Overland Park, KS 66210
(913) 469-8500
(913) 469-8525 (TDD)
(913) 469-4416 (Fax)

The school has developed sign language for business, data processing, electronics, algebra, and science.

For Mobility Impaired

Spinal Cord Injury Hotline
American Paralysis Association (APA)
c/o Montebello Rehabilitation Hospital
2201 Argonne Drive
Baltimore, MD 21218
(800) 526-3456

The Spinal Cord Injury Hotline is an information and referral service for people with spinal cord injury.

For Blind and Visually Impaired

American Council of the Blind (ACB)
1155 N. 15th Street, NW Suite 720
Washington, DC 20005
(800) 424-8666
(202) 467-5081

ACB is a national consumer and advocacy organization composed primarily of blind or visually impaired people. ACB supplies a student handbook and a faculty handbook. ACB affiliates include teacher and student groups.

National Federation of the Blind (NFB)
1800 Johnson Street
Baltimore, MD 21230
(410) 659-9314

The student division of this national organization of blind persons publishes *Post Secondary Educational and Career Development: A Resource Guide for the Blind, Visually Impaired and Physically Handicapped*, which gives advice on note taking, testing options, procedures for making campus contacts, places where texts can be transcribed, and, in addition, where materials of any sort can be located around the country. The Federation also offers scholarships to blind students and operates a national job listing and referral services in conjunction with the U.S. Department of Labor.

For Deaf and Hearing-Impaired

Alexander Graham Bell Association for the Deaf
3417 Volta Place, N.W.
Washington, DC 20007
(202) 337-5220 (V/TDD)

National Registry of Interpreters for the Deaf
814 Thayer Avenue
Silver Spring, MD 20910
(301) 608-0050 (V/TDD)

National Technical Institute for the Deaf (NTID)
Rochester Institute of Technology
One Lomb Memorial Drive
P.O. Box 9887
Rochester, NY 14623-0887
(716) 475-6400 (V/TDD)

NTID is the only technological college for deaf people in the world, it offers communication development packages, curriculum materials, and general information about deafness and the education of deaf people. NTID trains tutors, note takers, and interpreters and can help other organizations set up programs to do these things. NTID is creating a series of videotapes of technical signs used in academic settings. These are available through "New Trends for Instructing Deaf People," a free catalogue of educational materials from NTID.

National Information Center on Deafness (NICD)
Gallaudet University
Carnegie Hall, Room 205
800 Florida Avenue, N.E.
Washington, DC 20002
(800) 451-8835 ext. 5575 (V/TDD)
(202) 651-5052 (V/TDD)
(202) 651-5054 (Fax)
Bitnet: LJDiPietro@GALLUA

Gallaudet University, a multipurpose educational institution serving deaf students, offers various publications on deafness, hearing loss, and related topics. These include "The Deaf Student in College," which outlines how to meet the needs of deaf students on regular integrated campuses and "College and Career Programs and Deaf Students," which describes over 100 deaf student programs currently offered on campuses across the country. For more information on these and other publications contact NICD.

Self-Help for Hard-of-Hearing People (SHHH)
7800 Wisconsin Avenue
Bethesda, MD 20814
(301) 657-2248 (Voice)
(301) 657-2249 (TDD)

Sign Language Associates
1010 Wayne Avenue
Suite 420
Silver Spring, MD 20910
(301) 588-7591

The Washington Area Group for the Hard-of-Hearing
P.O. Box 6283
Silver Spring, MD 20916
(301) 942-7612

These organizations will provide information on a wide range of topics affecting students who are deaf or hard-of-hearing, including assistive listening devices and adapted technology.

For Learning and Communication Disabilities

National Center for Learning Disabilities (NCLD)
99 Park Avenue
New York, NY 10016
(212) 687-7211
(703) 451-2078

NCLD offers information, referral, advocacy, and outreach for individuals with learning disabilities.

Learning Disabilities Association of America (LDA)
4146 Library Road
Pittsburgh, PA 15234
(412) 341-1515
(412) 341-8077

LDA is a support and advocacy group for children with learning disabilities and their parents and teachers.

Learning Disabilities Network
72 Sharp Street, A2
Hingham, MA 02043
(617) 340-5605

The Network provides educational and referral services, primarily in the Northeast. Printed materials on learning disabilities are also available. Publishes a newsletter, "The Exchange."

Center on Postsecondary Education for Students with Learning Disabilities
Health Resource Center
The University of Connecticut, U-64
249 Glenbrook Road
Storrs, CT 06260-2064
(800) 544-3284
(203) 486-4036

The Center provides assistance on developing support services for students with learning disabilities. Publishes "The Postsecondary LD Network News."

Artificial Language Laboratory
Michigan State University
405 Computer Center
East Lansing, MI 48824-1042
(517) 353-5399
(517) 353-9847 (Fax)
Internet: john@all.cps.msu.edu

Publishes *Communication Outlook*, an international quarterly for individuals interested in the application of technology to the needs of persons with communication impairments due to neurological, sensory, or neuromuscular conditions.

The Orton Dyslexia Society
Chester Building, #382
8600 LaSalle Road
Baltimore, MD 21284
(800) 222-3123; 1-800 ABCD 123
(410) 296-0232
(410) 321-5069 (Fax)

The Society is committed to successful and appropriate teaching for dyslexics and shares up-to-date information about advances in the field through an extensive list of reprints and other readings.

National Network of Learning Disabled Adults (NNLDA)
808 North 82nd St., #F2
Scottsdale, AZ 85257
(602) 941-5112

TEACHING/ LABORATORY AIDS

The following products are listed solely to provide the reader with some examples of available teaching aids. This list is not intended to be comprehensive, nor is it meant to be an endorsement of these products and producers by the American Chemical Society. Rather, this is a compilation of teaching and laboratory aids known to members of the ACS Committee on Chemists with Disabilities (CWD). Readers are invited to send names/addresses of suppliers of products that they have found useful to CWD (p. 29).

General

Adaptive Living
Robert Van Etten
2 Charles Street
Rochester, NY 14608-1717
(716) 235-7270

Adaptive Living provides rehabilitative services and recommends assistive technology and converts equipment including computers for individuals with disabilities to facilitate more interactive use in the laboratory and workplace.

RESNA (Rehabilitation Engineering Society of North America)
1101 Connecticut Avenue N.W.
Suite 700
Washington, DC 20036
(202) 857-1199

RESNA staff can answer specific questions about adapting labs and classrooms for people with disabilities. RESNA also publishes *Technology for Independent Living Sourcebook*, a complete reference on available technology and sources of funding. RESNA provides *The Workplace Workbook: An Illustrated Guide to Job Accommodation and Assistive Technology*, by James Mueller.

Fisher Scientific Company
Contempra Furniture Division
922 Philadelphia Street
Indiana, PA 15701
(800) 955-0707

The division supplies a lab station that meets the requirements of Section 504 of the Rehabilitation Act of 1973 for students with orthopedic impairments.

Hamilton Industries
1316 18th Street, Box 137
Two Rivers, WI 54241
(414) 793-1121

Hamilton manufactures laboratory furniture that provides wheelchair access including special adjustable fume hood.

Computer Help

IBM Independence Series Information Center
Building 5, 3rd Floor
P.O. Box 1328
Boca Raton, FL 33429
(800) 426-4832 (Voice)
(800) 426-4833 (TDD)

Free information and guides provided for use of personal computers and a series of IBM products for persons with vision, hearing, mobility, speech, or language and learning impairments, which include:

1) Screen Reader, Phone Communicator, Access DOS and Key Guard (phone option 1).

2) Voice Type (phone option 2).

3) Speech Viewer I and II and Thinkable (phone option 3).

4) IBM Offerings to Persons with Disabilities, a pamphlet that makes it easier for persons with disabilities to purchase computers at a discount through 12 local Computer Assistive Technical Services (CATS) of the Easter Seal affiliates throughout the country (p. 36).

5) A directory of adaptive technology, *Technology for Persons with Disabilities: A Resource Guide*.

Apple Computer, Inc.
Worldwide Disability Solutions Group
and Alliance for Technical Accessibility
20525 Mariani Avenue
Mailstop 36SE
Cupertino, CA 95014
(408) 974-7910

Information and technical assistance are available regarding computer technologies available for use by persons with disabilities, including: "Solutions," a Hypercard stack of computer resources for individuals with disabilities, and "Connections," a guide to computer resources that may be used with Apple computers for persons with disabilities. Also see "When Versa Goes Apple for a Blind Chemist," by Jean-Pierre Cartier and Peter Jones, *Journal of Chemical Education*, 65, 525-37 (1988).

An adaptive technology directory, *Apple Computer Resources in Special Education and Rehabilitation*, can be obtained from Development Learning Materials, One DLM Park, Allen, TX 75002.

Trace Research and Development Center for Communication, Control and Computer Access
S-151 Waisman Center
1500 Highland Avenue
Madison, WI 53705
(608) 262-6966
(608) 263-5408 (TDD)
(608) 262-8848 (Fax)

The Trace Center provides information on microcomputer technology for persons with disabilities and has a catalogue of Publications & Media with up-to-date information on assistive technology, which lists among many other items:

1) *Trace Resourcebook: Assistive Technologies for Communication, Control and Computer Access* by J. R. Berliss, P. A. Borden, K. R. Ford, and G. C. Vanderheiden (1991-92 edition).

2) "Hyper-ABLEDATA," a Hypercard stack of rehabilitative and assistive devices for individuals with disabilities (4th edition, 1991), (requires Macintosh computer with Hypercard software). A version of Hyper-ABLEDATA for the IBM family of computers is available. There is also a Hyper-ABLEDATA demonstration videotape that shows the operation of the program and other Trace Center databases.

3) Trace Voice Sampler, a HyperCard stack that contains digitally recorded voice samples from major speech synthesizers.

Project EASI (Equal Access to Software for Instruction)
c/o EDUCOM/EUIT
1112 16th Street, N.W., Suite 600
Washington, DC 20036
(202) 872-4200
(202) 872-4318 (Fax)
Bitnet: EASI@EDUCOM
Internet: EASI@EDUCOM.EDU

Project EASI is a special interest group of EDUCOM. They provide resources on adaptive technology in higher education and produce publications, including *Computers and Students with Disabilities: New Challenges for Higher Education.*

Closing the Gap
Box 68
Henderson, MN 56044
(612) 248-3294
(612) 248-3810 (Fax)

Publishes a newspaper and yearly resource directory on software, hardware, and adaptive technology as well as sponsoring yearly conferences.

High Tech Center Training Unit
21050 McClelland Road
Cupertino, CA 95014
(408) 996-4636
(408) 996-6042 (Fax)
Internet: HTCTU@well.SF.CA.US

A guide to understanding the issues and technologies associated with computer access for persons with disabilities, *Computer Access in Higher Education for Students with Disabilities*, 2nd ed. (California Community Colleges Chancellor's Office High Tech Center for the Disabled) by Carl Brown, can be ordered from the High Tech Center.

Computer Assistive Technology Services (CATS)

Several Easter Seal Society affiliates provide information and services related to assistive technology. These affiliates also are qualified for the CATS program. The CATS affiliates listed below are resellers of voice recognition technology and other assistive technology products for people with limitations in the areas of vision, hearing, speech, mobility, and learning.

Arkansas Easter Seal Society
2801 Lee Avenue
Little Rock, AR 72225
(501) 663-8331

Easter Seal of Arizona
903 North Second Street
Phoenix, AZ 85004
(602) 252-6061

Easter Seal Rehab Center of Southwestern Connecticut
26 Palmer's Hill Road
Stamford, CT 06902
(203) 325-1544

Atlanta Easter Seal Society
3035 N. Druid Hills Road
Atlanta, GA 30329
(404) 633-9609

Central Indiana Easter Seal Society
Crossroads Rehabilitation Center
4740 Kingsway Drive
Indianapolis, IN 46205
(317) 466-1000 ext. 2013

Massachusetts Easter Seal Society
484 Main Street
6th Floor
Worcester, MA 01608
(508) 757-2756

Missouri Easter Seal Society
5025 Northrup
St. Louis, MO 63110
(314) 664-5025

Easter Seal of Rhode Island
Meeting Street School
667 Waterman Avenue
East Providence, RI 02914
(401) 438-9500 ext. 246

Tarrant Co. Easter Seal Society
617 Seventh Avenue
Fort Worth, TX 76104
(817) 336-8693

Utah Easter Seal Society
331 S. Rio Grande St., Suite 206
Salt Lake City, UT 84101
(801) 631-0522

Easter Seal Society of Virginia
4841 Williamson Road
P.O. Box 5496
Roanoke, VA 24012
(800) 365-1656
(703) 362-1656

Colorado Easter Seal Society, Inc.
5755 W. Alameda Avenue
Lakewood, CO 80226
(303) 223-1666

"Boston University Workshop on Computers and Persons with Disabilities, Final Report"
Boston University, October 2-3, 1989, compiled by Bryant W. York, Chairman. This report discusses issues surrounding computers and persons with disabilities in relation to National Science Foundation guidelines.

For Blind and Visually Impaired

American Foundation for the Blind (AFB)
15 West 16th Street
New York, NY 10011
(800) 232-5463
(212) 620-2000
AFB will provide information about issues involving students who are blind or visually impaired. AFB also supplies a catalogue that includes a talking calculator as well as other laboratory instruments with voice output. AFB publishes a book, *Tactile Graphics* (1992) (18), and has established a national technology center and database of professionals who use adaptive technology in their careers and in the workplace.

American Printing House for the Blind, Inc.
1839 Frankfort Avenue
Louisville, KY 40206
(502) 895-2405
(800) 223-1839
(502) 895-1509 (Fax)
The organization offers a light probe, talking calculator, and books in Braille and enlarged print.

Arkenstone, Inc.
1390 Borregas Avenue
Sunnyvale, CA 94089
(800) 444-4443
(408) 745-6739 (Fax)

This nonprofit organization is a provider of a range of reading machines for the blind and visually impaired as well as those with reading impairments.

Blazie Engineering
109 East Jarrettsville Road, Unit D
Forest Hill, MD 21050
(410) 893-9333

Provides Braille note-taking devices, Braille printers, and speech synthesizers.

Braille Book Bank
Braille Materials Production Center
National Braille Association, Inc. (NBA)
1290 University Avenue
Rochester, NY 14607
(716) 437-0900
(716) 473-4374 (Fax)

This committee coordinates all the duplicating and transcribing services for NBA, for college texts, math, and scientific tables. Catalogues of current materials in textbooks and technical tables are available. Braille transcribing services are also available.

Braille Technical Tables Bank
National Braille Association, Inc.
c/o Mrs. James O. Keene
31610 Evergreen Road
Birmingham, MI 48009

The Association supplies thermoform copies of math and scientific tables.

Enabling Technologies Company
3102 Southeast Jay Street
Stuart, FL 33497
(800) 777-3687 (DOTS)
(407) 283-4817

Puts out an IBM-based Braille graphics package, ET Graphics, which can import images from paint programs using formats like PCX and TIF. Manufactures Braille production equipment.

G W Micro
310 Racquet Drive
Fort Wayne, IN 46825
(219) 483-3625

Provides screen access systems, speech synthesizers, and screen magnification.

Human Ware Inc.
6245 King Road
Loomis, CA 94650
(800) 722-3393

Provides systems integration for blind and visually impaired computer users with screen access systems, refreshable Braille displays, Braille embossers, Braille translation software, Braille note takers, screen magnification software, and closed-circuit TV (electronic magnifiers for people with low vision).

L.S.& S. Group, Inc.
P.O. Box 673
Northbrook, IL 60065
(708) 498 4777

Provides a catalogue for instruments and devices for the visually impaired and those with communication problems.

Microsystems Software, Inc.
600 Worcester Road
Framingham, MA 01701
(508) 626-8511

Provides screen magnification software for the visually impaired.

Raised Dot Computing, Inc. (RDC)
408 South Baldwin
Madison, WI 53703
(608) 257-9595

RDC publishes a bimonthly newsletter for its products and other helpful hardware, software ideas, and comments for the visually impaired. RDC has a broad graphics package called pixCELLS for the Apple II.

Recording for the Blind (RFB)
20 Roszel Road
Princeton, NJ 08540
(800) 221-4792

This organization provides cassette tapes of educational textbooks (from K to postsecondary levels). 78,000 titles are currently available; other titles are recorded upon request. Electronic text versions of some technical books including computer manuals are available for a nominal fee. After a $25 one-time fee this service is free for the blind, the visually impaired, and for those with a documented learning disability; the materials are on loan. There is a free E-Kit diskette issued quarterly that explains RFB services and updates its catalogue of both tapes and diskettes.

Computerized Books for the Blind (CBFB) merged with RFB in 1991 and E-Text floppy diskettes are available. The cost will vary depending on the number of diskettes required for the book. These diskettes can be used on IBM and IBM compatibles, Apple and Macintosh computers for large-print screen viewing, for Braille output, and with a speech synthesizer. For further information on available titles call the RFB reference library, (609) 452-0606.

Sargent, Welch Corporation
P.O. Box 1026
Skokie, IL 60076-8036
(800) 727-4368
(708) 677-0600

Sargent, Welch Corporation is a dealer handling many instruments with binary code decimal (BCD) digital output. Some of these instruments are spectrophotometers, pH meters, Mettler balances, Ohaus balances, and electronic counters. Instruments such as the Port-O-Gram Electronic Ohaus Balance can be made "talking" with a voice box supplied by American Foundation for the Blind (p. 37).

Science Products
Box 888
Southeastern, PA 19399
(800) 888-7400

Manufactures special products such as calculators and various meters with talking output for the visually impaired and has a variety of magnifiers. Staff experience in the fields of digital voice technology and equipment adaptation is extensive.

Sewell Metal Processing Corporation
4125 58th Street
Woodside, NY 11277
(718) 458-4100

Manufactures the Sewell Raised Line Drawing Kit and the Marks Script Guide.

Smith-Kettlewell Eye Research Institute
Mr. William Gerrey
2232 Webster Street
San Francisco, CA 94115
(415) 561-1677

Provides service on modification of equipment to aid persons with visual impairments in the laboratory.

Xerox Imaging Systems, Inc.
9 Centennial Drive
Peabody, MA 01960
(800) 421-7323
(508) 977-2000
(508) 977-2148 (Fax)

Provider of the Kurzweil reading machine for people with visual impairments. The Reading Edge is a portable bookedge reader that provides access to most printed material.

For Deaf and Hearing-Impaired

Captioned Films for the Deaf Distribution Center
Modern Talking Picture Service
5000 Park Street, North
St. Petersburg, FL 33709
(800) 237-6213 (V/TDD)

The Center produces and distributes captioned films. Educational and theatrical films are catalogued, the majority being for primary and secondary schools on nonscientific subjects. There are a few films that have a sound track synchronized with captions, some of which deal with basic chemistry concepts.

National Technical Institute for the Deaf (NTID)
Rochester Institute of Technology
One Lomb Memorial Drive, P.O. Box 9887
Rochester, NY 14623-0887
(716) 475-6400 (V/TDD)

Persons who take notes for students with hearing or mobility impairments find that a special noncarbon notepad produced by NTID allows them to make multiple copies at one writing. The notepads and other educational aids are listed in a free catalogue, "New Trends for Instructing Deaf People," available from NTID Information Office. NTID can also be contacted for interpreters.

The Caption Center
WGBH
125 Western Avenue
Boston, MA 02134
(617) 492-9225 (V/TDD)

The Center will develop captions for video tapes and also Descriptive Video Service (DVS) for persons with visual impairments. It captions NOVA and other educational videos.

National Registry of Interpreters for the Deaf, Inc.
8719 Colesville Road, Suite 310
Silver Spring, MD 20910
(301) 608-0050 (V/TDD)

For Learning Disabilities

Peterson's Guide to Colleges with Programs for Learning Disabled Students
Edited by Charles T. Magnum II and Stephen S. Strichart (2nd edition, 1988). Available from Peterson's Guides, P.O. Box 2123, Princeton, NJ 08543-2123; (800) 338-3282; (609) 243-9150.

ComputAbility
4000 Grand River, Suite 109
Novi, MI 48375
(800) 433-8872

Provides educational software for students with learning disabilities.

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ACKNOWLEDGMENTS

The National Science Foundation initially funded this project, which was organized by the American Chemical Society with Dr. Moses Passer as Project Director and Dr. James J. Hazdra, Workshop Chairman. The ACS Committee on the Handicapped, chaired by Dr. Thomas Kucera, was invited to aid in the selection of participants for the April 1980 workshop and to act as the steering group for the project. Mr. Kenneth M. Reese was the editor of the first edition of this manual, published May 1981.

Participants were selected from a list of disabled chemists supplied by AAAS, from a notice in *Chemical & Engineering News*, and from the American Chemical Society's Committee on the Handicapped. Criteria used in selection included:

(1) achieve a balance among three areas of physical impairments: hearing, visual, and motor;

(2) include chemical educators interested in teaching chemistry to persons with disabilities but not necessarily disabled themselves;

(3) choose participants who were disabled prior to receiving their degrees in chemistry; and

(4) include at least one disabled undergraduate majoring in chemistry.

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ISBN 0-8412-2734-9